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PATENT SPECIFICATION

(11) 1240913

NO DRAWINGS

1240913

- (21) Application No. 47418/69 (22) Filed 26 Sept. 1969
 (31) Convention Application No. 764 918 (32) Filed 3 Oct. 1968 in
 (33) United States of America (US)
 (45) Complete Specification published 28 July 1971
 (51) International Classification C.10 g 31/14
 (52) Index at acceptance CSE 12C



(54) PRODUCTION OF IMPROVED LUBRICATING OILS

(71) We, TEXACO DEVELOPMENT CORPORATION, a Corporation organized and existing under the laws of the State of Delaware, United States of America, of 135 East 42nd Street, New York, New York 10017, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production of improved lubricating oils. More particularly, it is concerned with a process sequence for the production of lubricating oils of high viscosity index. In one of its more specific aspects, it is concerned with the production of high viscosity index lubricating oils from low grade lubricating oil charge stocks using a process sequence which includes hydrorefining without resort to severe hydrorefining conditions.

Various steps for the refining of lubricating oils such as distillation, solvent refining, solvent dewaxing, acid treating and clay contacting are well known. When residual type oils are being processed, a preliminary step of deasphalting is also generally required.

In the processing steps listed above distillation is employed as a means of separating a crude oil into fractions of various viscosities, solvent refining with, for example, furfural, sulfur dioxide, phenol or N - methyl-2 - pyrrolidone is ordinarily used as a means of removing aromatic compounds and thereby improving the viscosity index, solvent dewaxing using for example a mixture of methyl ethyl ketone and toluene is used to lower the pour point of the oil, acid treating is used to improve the color stability and resistance of the lubricating oil to oxidation, and clay contacting is used generally as a final step to further improve the color and to neutralize the oil after acid treating.

Catalytic hydrogenation of lubricating oil is a method of refining lubricating oils with hydrogen in the presence of a catalyst and

has the advantage over solvent refining to improve the viscosity index, and over clay treating to improve the color in that the yields of treated oils are much higher for the hydrogenation process than for solvent refining and clay treating. Further, oils of higher viscosity index can be produced by the hydrogenation process than is practical by solvent refining. It has therefore become advantageous in the lubricating oil refining art to use hydrorefining as a substitute for solvent refining and clay treating and to complete the refining process by solvent dewaxing. Unfortunately, subjecting a lubricating oil to a dewaxing treatment to reduce the pour point also results in an undesirable reduction of the viscosity index. In a processing sequence involving hydrorefining, it has therefore become necessary, in order to obtain a high viscosity index dewaxed product, to carry out the hydrorefining under extremely severe conditions to produce a lube oil of sufficiently high viscosity index that after dewaxing a product oil is obtained having the desired viscosity index. This severe hydrorefining is undesirable not only in that it requires severe conditions such as high temperatures and low space velocities but also in that it results in a low product yield. Lowering the space velocity of the oil through the catalytic reactor means a reduced capacity in terms of throughput, and to compensate by constructing a larger reactor represents a large increase in investment costs both as to the equipment and catalyst.

The present invention provides a novel combination of steps for producing a lubricating oil having an improved viscosity index. It is possible to produce an improved lubricating oil using moderate hydrorefining conditions, an improved dewaxed lubricating oil in good yield having a superior viscosity index at the same viscosity level as severely hydrorefined oil, and a lubricating oil of good color and color stability.

According to the process of our invention,

catalysts for use in
 comprise metals
 Group VI and
 Table. Examples
 chromium, molyb-
 denum and nickel
 and these components
 comprising a refrac-
 tory such as alumina,
 silica, and mixtures
 used in the form
 of a fixed bed,
 or a fixed bed, the
 or downwardly
 may be counter-
 currently suitable
 from 3—10%
 molybdenum
 is are those con-
 taining 20% tungsten
 cobalt and 15%
 alumina. Although
 chemical change
 the presence of
 the catalyst is
 oxide or sulfide
 with the charge.
 is subjected to
 nt of our inven-
 the hydrorefining
 out intermediate
 a catalyst com-
 ponent, such as
 g catalyst, sup-
 ported on a mordenite. Prefer-
 treating a syn-
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 ion. Advantage-
 is treated with
 portion of the
 to produce a mordenite
 and increased
 in dewaxing may
 be of at least
 at 100 psig, and
 Naturally when
 reduced directly
 zone, the hydro-
 waxing zone, sub-
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 zone as the hydro-
 zone. Preferred
 waxing zone are
 a pressure of
 velocity of 0.20—
 and light hydro-
 from the hydro-
 oil then con-
 such as a mix-
 ture of methyl-
 ethyl ketone or a mix-
 ture of methyl-
 ethyl ketone in
 by volume of
 mixture cooled

to a temperature of about 0 to -20°F. and
 the waxy components removed by filtering or
 centrifuging. The filtrate is then subjected to
 flash distillation and stripping to remove the
 solvent.

By interposing a solvent refining step be-
 tween the distillation or deasphalting step and
 the hydrorefining step it is now possible to
 obtain a dewaxed product at a specified vis-
 cosity index for a particular viscosity using
 milder hydrorefining conditions, particularly
 the space velocity, than was possible using
 the processes of the prior art. Operating the
 hydrorefiner at increased throughput is advan-
 tageous in that a smaller unit need be built
 for a particular capacity or in cases where
 the unit is already built, the capacity is

greatly increased, in some instances as much
 as 400%.

The invention will now be illustrated by
 the following examples, in which Examples
 1 and 3 are given for comparative purposes.
 In these Examples, "Flash °F. (PM)" refers
 to the Pensky-Martens test (ASTM D93—62)
 and "Flash COC, °F." refers to the Cleve-
 land Open Cup test (ASTM D92—57).

EXAMPLE I

In this example the charge is a deasphalted
residuum having the characteristics set forth
 in column A of Table 1 below. For com-
 parison purposes, the characteristics of the
 dewaxed charge are listed in column B.

TABLE 1

	A	B
Gravity, °API	25.5	23.5
Flash, °F.	560 (COC)	500+ (PM)
Viscosity, SUS/210°F.	121.8	139.6
Viscosity Index	87	79
Pour, °F.	+110	-5

Hydrorefining conditions over a catalyst
 composed of 5.9% Ni and 18.3% W sup-
 ported on an alumina base and characteristics
 of the MEK:toluene dewaxed hydrorefined
 product are tabulated below.

TABLE 2

Process Conditions		
Run No.	1	2
Reactor Temp. °F.	800	775
Pressure, psig.	2500	2500
Space Velocity, v/v/hr	0.49	0.21
Hydrogen rate, SCFB	4520	6300
Product (Dewaxed)		
Gravity, °API	30.9	31.4
Flash, °F. (PM)	375	380
Viscosity, SUS/210°F.	50.5	50.6
Viscosity Index	117	118
Pour, °F.	+10	-5
Overall Yield, vol. %	63	61

EXAMPLE II

In this example, the same charge stock used in Example I is subjected to a preliminary solvent extraction using furfural as the solvent and the so-treated oil is then

hydrorefined and dewaxed. Operating data of the process and characteristics of the charge and product appear below. Data on the dewaxed charge are included for comparison purposes.

TABLE 3

Tests	Charge	Dewaxed Charge
Gravity, °API	28.6	27.6
Flash, °F.	570 (COC)	425 (PM)
Viscosity, SUS/210°F.	102.3	112.3
Viscosity Index	105	95
Pour, °F.	+120	0
Process Conditions		
Run No.	3	4
Reactor Temp., °F.	800	773
Pressure, psig.	2500	2500
Space velocity, v/v/hr.	0.47	0.26
Hydrogen rate, SCFB	4700	5100
Product (Dewaxed)		
Run No.	3	4
Gravity, °API	33.3	32.9
Flash, °F. (PM)	385	385
Viscosity, SUS/210°F.	49.5	50.4
Viscosity Index	128	124
Pour, °F.	+5	+5

Lube oil yield from Run 3 hydrorefining step is 71.5 volume per cent and from Run 4 hydrorefining step is 72 volume per cent.

EXAMPLE III

In this example, the charge is a wax dis-

illate having the characteristics set forth in Column A of Table 4. For comparison purposes, the characteristics of the dewaxed charge are listed in Column B.

Hydrorefined
composed
supported

10 in
solvent
and

TABLE 4

	A	B
Gravity, °API	22.4	21.3
Flash, COC, °F.	420	—
Viscosity, SUS/210°F.	57.9	62.0
Viscosity Index	70	56
Pour, °F.	+100	0

Hydrotreating conditions over a catalyst composed of 5.9% Nickel and 18.3% tungsten supported on an alumina base and the characteristics of the MEK:toluene dewaxed hydrorefined product are tabulated below.

TABLE 5

Process Conditions	Run 5
Temperature, °F.	775
Pressure, psig.	1500
Space Velocity, v/v/hr.	0.25
H ₂ rate, SCFB	5000
Product (Dewaxed)	
Gravity, °API	29.6
Flash, COC, °F.	400
Viscosity, SUS/210°F.	43.7
Viscosity Index	100
Pour, °F.	-5
Overall Yield, vol. %	51

EXAMPLE IV

In this example the same charge as used in Example III is subjected to preliminary solvent refining using furfural as the solvent and then is mildly hydrotreated and dewaxed.

Characteristics of the charge, product and reaction conditions are tabulated below. Data on the dewaxed charge are included for comparison purposes.

TABLE 6

Charge	As Used	Dewaxed
Gravity, °API	30.0	28.4
Flash, COC, °F.	370	—
Viscosity, SUS/210°F.	50.7	54.0
Viscosity Index	107	89
Pour, °F.	+105	0

Operating data of
s of the charge
Data on the de-
for comparison

10

Charge

M)

cs set forth in
omparison pur-
dewaxed charge

20

Hydrotrefining conditions over a catalyst composed of 5.9% nickel and 18.3% tungsten supported on an alumina base and the characteristics of the MEK:toluene dewaxed hydrorefined product are tabulated below.

TABLE 7

Run No.	6	7
Process Conditions		
Temperature, °F.	775	775
Pressure, psig.	1500	1500
Space Velocity, v/v/hr.	1.0	0.5
H ₂ rate, SCFB	5000	5000
Product (Dewaxed)		
Gravity, °API	30.5	31.8
Flash, COC, °F.	400	395
Viscosity, SUS/210°F.	46.2	43.1
Viscosity Index	101	110
Pour, °F.	0	-20
Overall Yield, vol. %	73	65

It will be observed from Table 5 that by conventional processing, a space velocity of 0.25 yielded a product having a viscosity index of 100 and viscosity SUS/210°F. of 43.7. Table 7 shows that by our process, a product oil of essentially the same viscosity index can be obtained at a space velocity of 1, a rate 4 times as fast as in Run 5 and also an oil having an improved viscosity index of 110 can be obtained at twice the flow rate of Run 5. Lube oil yield from Run 6

hydrorefining step is 86.5 volume per cent and from Run 7 hydrorefining step 77.7 volume per cent.

EXAMPLE V

This example shows the improved colour obtained by our process. In Table 8, vast improvement is shown in Runs 3 and 6 from above where the oil is furfural refined before hydrorefining over Runs 1 and 5 where the furfural refining step is omitted.

TABLE 8

Hydrotrefining Run No.	1	3	5	6
Charge Color, Lovibond 4"	440	105	220	25
Product Color, Initial, Lovibond 6"	175	45	45 1/4"	50
Product Color after 24 hrs./200°F. Lovibond 6"	—	55	45 1/4"	55

WHAT WE CLAIM IS:—

1. A process for the production of a lubricating oil of improved viscosity index which comprises subjecting a lube oil charge stock

to solvent extraction to reduce the aromatic content thereof, passing the solvent treated material into contact with a hydrorefining catalyst under hydrorefining conditions and

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- then subjecting the hydrorefined material to dewaxing.
2. A process as claimed in claim 1, in which the hydrorefined product is catalytically dewaxed.
3. A process as claimed in claim 2, in which the hydrorefining zone effluent is passed directly to the catalytic dewaxing zone.
4. A process as claimed in claim 1, 2 or 3, in which the dewaxing catalyst comprises a hydrogenating component supported on decahedral mordenite.
5. A process as claimed in claim 1, in which the hydrorefined material is solvent dewaxed.
6. A process as claimed in any preceding claim, in which the charge stock has a viscosity index not greater than 90.
7. A process as claimed in any preceding claim, in which the charge stock has a viscosity index below 75 and the dewaxed product has a viscosity index of at least 100.
8. A process as claimed in any preceding claim, wherein the hydrorefining catalyst comprises cobalt or nickel and molybdenum or tungsten.
9. A process as claimed in any preceding claim, wherein the hydrorefining conditions comprise a temperature between 600 and 900°F., a pressure between 800 and 5000 psig, a hydrogen rate between 1500 and 20,000 SCFB and a space velocity between 0.1 and 5.0 volume of oil per volume of catalyst per hour.
10. A process for the production of a lubricating oil substantially as hereinbefore described with reference to Examples 2, 4 or 5.
11. Lubricating oils whenever prepared or produced by a process claimed in any of the preceding claims.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1971.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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